



## PROPOSAL CRP AND FLAGSHIP NARRATIVES

# Livestock Agri-food Systems

## CGIAR Research Program

Presented by the International Livestock Research Institute (ILRI) with :  
German Development Agency (GIZ), International Center for Agricultural  
Research in Dry Areas (ICARDA), International Center for Tropical Agriculture  
(CIAT), International Water Management Institute (IWMI), Swedish University  
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Agroforestry Center (ICRAF)



*Science for a food secure future*



Proposal  
Livestock Agri-Food Systems CGIAR Research  
Program  
LIVESTOCK LIVELIHOODS AND AGRI-FOOD  
SYSTEMS FLAGSHIP NARRATIVE

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## 2.5 Livestock Livelihoods and Agri-Food Systems

### Box 2.5a: Livestock Livelihoods and Agri-Food Systems Flagship – Summary

The objective of this Flagship Project (FP) is to ensure that the CRP has its intended impact on the key sub-IDOs related to livelihoods and gender, among others – in short ensuring that the technologies and strategies developed through the CRP translate into positive impacts on the welfare of the resource poor.

This FP:

- Delivers interventions at producer, market and policy level that positively impact rural livelihoods, nutrition, gender inequity, and livestock agri-food system performance, with livestock mediated livelihoods and wellbeing as its core aim
- To maximize overall CRP performance, provides the integrative mechanisms for technologies and strategies from the CRP technology and environment FPs to be piloted and implemented among target livestock keepers and communities
- Supports and coordinates the entire CRP and its FPs on priority setting, impact assessment, and gender
- Leads the CRP policy and investment analyses to prioritize and provide evidence for promoting livestock opportunities for the poor
- Identifies evidence-based best practices to facilitate scaling by partners of innovation addressing the unique opportunities afforded by livestock value chains
- Provide key linkages for joint research with the PIM CRP for foresight, gender, and scaling, and to the AHNH CRP for human nutrition
- Invests in cross-site and cross-system syntheses to ensure that lessons from multiple bilaterally funded interventions generate IPGs

Contributes directly to the following sub-IDOs:

- Increased access to diverse nutrient-rich foods
- Reduced market barriers
- Increased livelihood opportunities
- Gender-equitable control of productive assets and resources
- Improved capacity of women and youth to participate in decision making
- Conducive agricultural policy environment

### 2.5.1 Flagship Project Narrative

#### 2.5.1.1 Rationale and scope

##### Why research on livestock and livelihoods in developing countries?

The case has been made in Sections 1.0.1 and 1.0.3 for the strategic importance of livestock production generally, the main trajectories in which it is evolving, and the opportunity it offers to contribute to achieving the SLOs and SDGs. One of the key objectives of the Livestock CRP is to maximize livestock-mediated livelihoods and resilience to risk among livestock producers and their communities, at the same time as increasing the availability of and access to animal-source foods for rural and urban consumers. The role of livestock in supporting livelihoods, whether for increased market orientation in a rapid inclusive growth trajectory or to strengthen resilience in a fragile growth trajectory, is a vital one. Maximizing this role, along with broader welfare implications for gender, equity and nutrition, is the focus of this FP. In addition, given the aim of improving welfare more broadly, the FP aims to deliver outcomes to support gender equity and child nutrition, given their important implications in the context of livestock systems and animal sourced foods (ASFs).

We will make the case below that to effectively deliver interventions and strategies to improve livelihoods, we must take a holistic and integrated approach that captures the complex interactions between production technologies, markets, institutions, and their socio-economic context all of which affect farm and **agri-food system performance**, which also overcomes barriers that **gender inequities** might present, exploits new opportunities for **youth**, and does not assume that more ASFs produced in the household will necessarily lead to **improved nutrition** but which actively explores pathways for making that happen. The performance of livestock systems in generating livelihood impacts is also

closely linked to the dynamics of evolving systems and markets, and on the levels and types of **investment in technology and development** and on the **policies** influencing all these. These interacting components form the research priorities for the FP.

In this FP, as in the CRP overall (1.0.1) we aim to have impact among those small and medium-scale producers and market agents where the livelihood and welfare opportunities are greatest, and which still produce the bulk of the ASF supply in our target CRP countries. The CRP proposal narrative has already highlighted the large and somewhat unique roles that livestock production and value chains play in **providing opportunities for rural livelihoods** (1.0.1). Livestock contribute some 40% of agricultural GDP in developing countries, a share which is steadily growing. This translates at a local level into **important implications for livelihoods** and rural incomes. In many rural settings, livestock keeping comprises the most important part of individual household incomes and livelihoods, contributing most household income in many countries (Staal *et al.*, 2009). Livestock products have high unit market values, so that **livestock products are relatively more marketed than most food crops**, and so play a large role in income generation, on farm and along the value chain. Moreover, research has shown that the **livestock sector generally exhibits greater rural livelihood multiplier effects than crops** (ReSAKSS 2016). A unique feature of livestock lies in their value as inflation-resistant assets which improves resilience, by providing ready cash when needed and a **means to save reliably and as well as insuring against risk** (Moll *et al.*, 2007). These assets are typically invested in other enterprises, multiplying livelihood opportunities or invested in children's education, contributing to a **generational escape from poverty and even to exit from agriculture**. Livestock also play some unique and important roles for women and marginalized members of some communities, as described in detail in the CRP proposal (1.0.4).

Small and medium scale livestock producers however face enormous challenges to exploit growing markets. Livestock productivity is low in our target countries, with yield gaps up to 300% (Herrero *et al.*, 2015). Farmers often **lack access to the knowledge, inputs and services to increase productivity and profitability**. **Gender disparities hold women back** while young people's involvement in livestock enterprises is constrained by access to capital (land, financial) and cultural norms. Low productivity of livestock **limits both the direct and indirect contributions of animal production to food and nutrition security**, especially among the poor. This is further exacerbated in poor-performing markets by reduced affordability and accessibility of **nutrient-dense animal-source foods, small amounts of which are critical** for the health of the most vulnerable. Successful efforts to **link small and medium-scale producers to formal markets have been limited to specific markets and products** such as dairy hubs or contract production of poultry. Informal markets thus continue to dominate but are subject to inefficiency and market risk, and are challenged by consumers wanting better quality and safe products. While demand will increasingly be met from large-scale production for some species, currently **most ruminant product supply will continue to come from small and medium scale producers and agro-pastoral systems** (Herrero *et al.*, 2014). However, **the models and data available** to understand and project future system changes are **currently very imperfect**. These factors limit the ability of decision-makers and donors **to appropriately target and assess the returns on investment and interventions** for desired impact.

### **Addressing the grand challenges**

The main challenge being addressed by this FP is that of continued significant rural poverty in the CRP target countries. Of the challenges listed in the SRF, we will address: (i) options for youth enterprises and employment in livestock production and supply chains, particularly in SSA; (ii) integrated production technology and gender-transformative approaches to address labour demands and reduce competition for land and improve production efficiency; (iii) malnutrition, particularly among women of reproductive age and young children, through approaches that increase consumption of high-value animal-source food; and (iv) improved soil nutrient levels through manure and crop-livestock integration.

### **Why should the CGIAR invest in this?**

The ex-ante impact assessment that was independently conducted as part of the CRP proposal development, **indicates that this flagship's research scores highly in addressing the CRP's multiple objectives and in generating a high return on investment.** Besides being a good investment, the CGIAR is unique in its capacity to link livestock research to development outcomes. No other organization dedicated to research for development has demonstrated the breadth of perspective and "low interdisciplinary boundaries" required to understand the complexity of evolving livestock systems and the interplay between technology and the socio-economic context (Barrett, 2017). And within this space, no other organization is positioned as strategically with extensive networks of partners among advanced research institutes globally and, critically, among regional and national stakeholders (Mancours 2017), particularly within our priority countries. This flagship builds on these strengths to more directly tackle the challenge of generating global public goods that improve successful uptake of research outputs through better targeting, design and evaluation of livestock-based interventions.

### **Overall goal**

The goal of the FP is to maximize the role of livestock in improving livelihoods and increasing resilience to risk among women and men smallholder, medium-scale and pastoral producers and their communities in target counties, while also increasing the supply of ASFs.

#### **2.5.1.2 Objectives and targets**

The FP will contribute directly to sub-IDOs on **increased access to diverse nutrient-rich foods, reduced market barriers, increased livelihood opportunities, gender-equitable control of productive assets and resources, improved capacity of women and youth to participate in decision-making, and a conducive agricultural policy environment.**

The FP's objectives are:

- Conduct foresight, impact and policy analysis to set priorities and guide inclusive and sustainable investments by the CRP and by public and private actors.
- Improve livestock technology and innovation and adoption by ensuring that gender-based analysis informs research design and implementation across the CRP and that delivery and scaling outcomes are equitable.
- Identify, test, and facilitate livestock-mediated pathways to improve nutrition in resource poor households and their communities.
- Improve rural livelihoods, through integrated production technologies and institutional innovations in markets and services to improve the performance of animal-source food systems.

### **FP outcomes to 2022**

- Gender equity relative to their level of effort (i.e. labour) at household level in the use of, and control of income generated by, livestock related productive assets and resources, impacting 288,000 women across four countries.
- Improved capacity of 1 million women and young people to participate in livestock related decision-making in five countries.
- Three million poor people (men and women), in four countries, with an increase in access to more affordable, safe, and nutrient rich animal-source foods.
- Innovative institutional options that improve resilience that are tested and adopted by national and international research & development partners, increasing the resilience of 356,000 rural livestock-keeping households (1.7 million individuals) in three countries.
- A 15% Increase, on average in total household income from livestock-related activities, including a 25% increase, on average, in the proportion controlled by women, for 449,000 households (& 2.2 million individuals) in eight countries.
- 454,000 livestock keeping households (representing 2.2 million individuals, including women) increase their supply of livestock to the market by 15%, on average, in seven countries.

- Policies and investment within and across four countries at local, country and regional level explicitly include pro-poor livestock mediated development, reaching 2 million livestock keepers & other value-chain actors.


### 2.5.1.3 Impact pathway and theory of change

Figures 2.5a and 2.5b present the FP's ToC and assumptions. Meeting the FP's goal will be achieved through four linked clusters of activity, each responding to specific challenges and opportunities within the rapid inclusive and fragile livestock growth trajectories.

In the CRP priority countries, the FP will integrate the work of the other FPs and continue with the value chains work pioneered in the Livestock and Fish (L&F) CRP. The FP's work on policies, foresight and systems analysis will ensure that the CRP's research remains demand driven, directed towards interventions that optimize impact and minimize trade-offs among objectives. Outcomes from the other three clusters will provide evidence, contributing to better informed priority setting, investments, and policy making (arrow from cluster 2, 3 and 4 outcomes). Cluster 2 work focuses on integrating gender and social equity, to ensure that CRP interventions are based on the accurately identified needs, preferences, and potential of women, and youth. The FP through cluster 3 will also look at influencing decision makers to implement new approaches for enhancing livestock-mediated nutritional impact, by an improved understanding of the different pathways between livestock keeping and improved nutrition, ultimately leading to increased access to diverse nutrient-rich foods. The last cluster on 'Integrated technologies, practices, and institutions for improved livestock systems' will provide inter-disciplinary research to identify, test and evaluate best bet technologies and management strategies for improved on-farm productivity, combining the technologies from the animal health, feed and forages and genetics FPs into packages of interventions that have increased relevance to women and men livestock keepers and their communities.

A critical element to facilitating change will be to work through partners. The FP will continue partnering with its target primary users of knowledge products, particularly actors in livestock research and development (as detailed in the Partnership section), facilitating capacity development, lesson learning, and testing proven best-bet interventions to subsequently scale up research outcomes. Linked communication and policy advocacy efforts, again through partners, will ensure greater attention to livestock development and investment, and movement towards pro-poor policies. The assumptions linked to these changes are listed in Figure 2.5b. Importantly, CRP W1/2 resources will strategically complement the bilateral resources that fund the bulk of the program, to ensure that cross-site and cross-system learning is captured and delivered to key audiences as globally relevant IPGs, which will promote expanded uptake and impact.

**Figure 2.5b**



Assumptions	
A1	National and international research partners will make decisions based on scientific evidence, including considerations of gender equity
A2	Gender-transformative approaches will translate into lasting inter- and intra- household benefits for poor households
A3	Newly adopted gender and other social norms will support equitable access to resources and participation in decision making
A4	Livestock keepers are willing and able to adopt productive, gender responsive and inclusive technologies
A5	Household resources allocation will be based on evidence and on equity concerns
A6	Systems are currently sub-optimal and there's room for win-win interventions
A7	More efficient market structures will be put in place
A8	Public & private actors are willing and able to invest in new institutional arrangements
A9	Demand for livestock and livestock products is adequate
A10	Market structures are adequately efficient to respond to changes in investment, policy and information
A11	There will be an enabling policy environment



**Figure 2.5a: Livestock Livelihoods and Agri-Food Systems Flagship theory of change, assumptions and change domains**

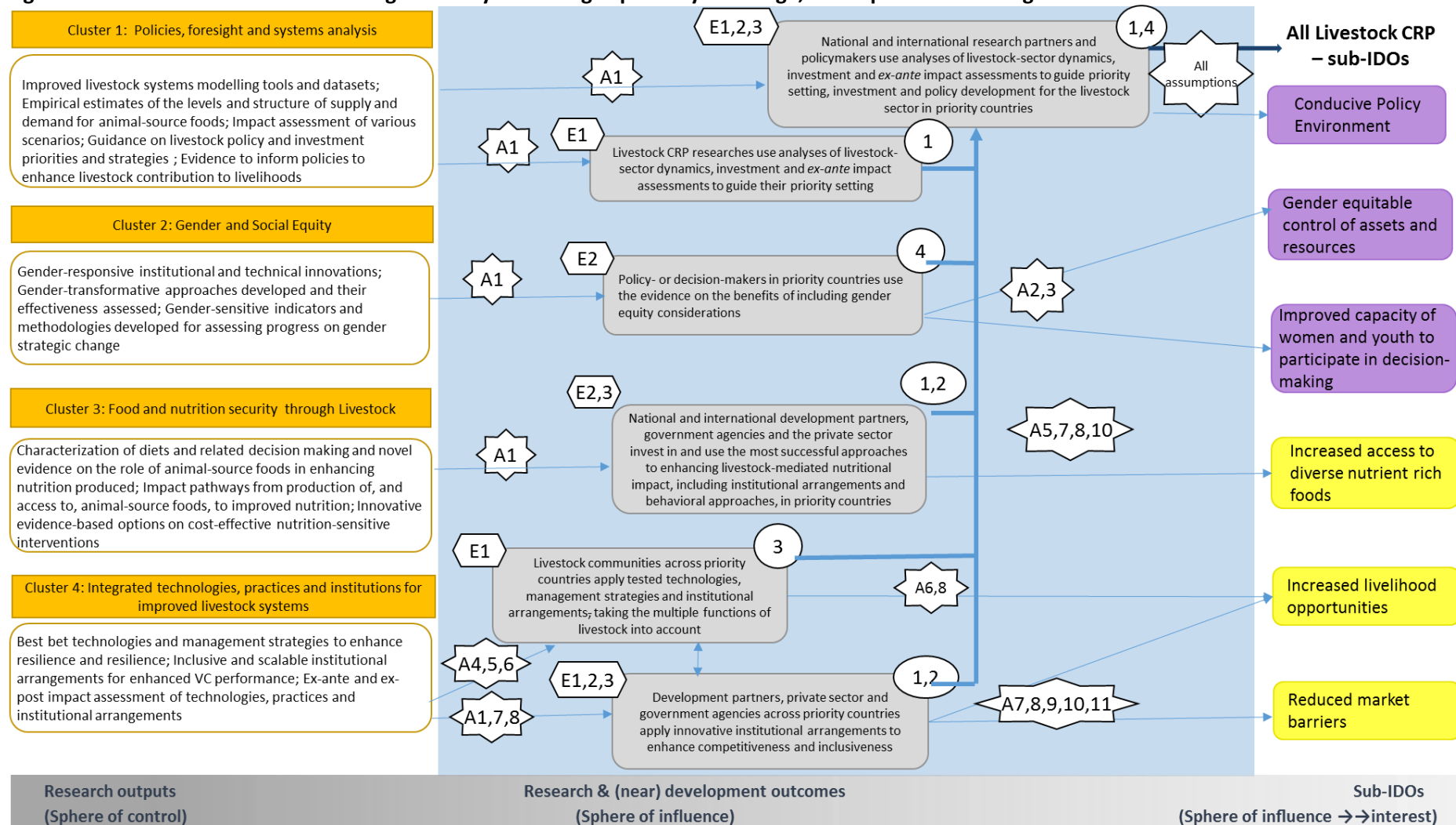


Figure 2.5b continued

Enabling cross-cutting actions		E1	Domains of change		1
E1	'Next user' capacity development		1	Changes in local, national and international research and development systems	
E2	Linked communication and policy advocacy efforts to ensure greater attention to livestock development and investment, and movement toward pro-poor policies		2	Changes in markets, enterprises and consumer behavior	
E3	Influencing investors and major donors to increase their efforts on livestock research for development		3	Changes in producers systems (producers and communities)	
			4	Changes in policies and investment systems for scaling	

#### 2.5.1.4 Science quality

This FP will develop and pursue four integrated themes of research which build on and add new innovations to the work of the L&F CRP.

First, (Cluster 1) in collaboration with national and international partners, the FP will develop new livestock system modeling tools and datasets, and conduct analysis of the impact of technology, policy, investment and livestock system evolution on a range of production, resource, and human welfare outcomes. This will also support the CRP research prioritization using innovative tools of spatial targeting and impact. This FP builds on systems work in previous CRPs, including L&F, PIM and Humidtropics, where ILRI led the strategic research theme on systems analysis. Projections of future livestock demand and supply at national and global levels under alternative scenarios will adapt the IMPACT model (Robinson, et al., 2015), an integrated assessment model that is widely used in investment prioritization for the global agricultural sector. FP team members contributed to recent development of the livestock module of IMPACT (Msangi *et al.*, 2014); and will oversee further improvement of the data and model and of the model linkages to other types of livestock system analysis. This exercise will benefit from expertise and long-standing collaboration between ILRI, IFPRI, FAO, CSIRO, and others. The team also has a proven track record in livestock-sector mapping and spatial analysis which is a key part of the datasets for foresight analysis, applied to analyses of poverty, health, nutrition and the environment (Robinson et al., 2011), and in livestock yield gap analytical approaches to define technological and investment needs of the sector (Herrero *et al.*, 2015). FP team members have worked on compilation and analysis of multiple household datasets to explain the role of livestock in household food and nutrition security, (e.g. Frelat *et al.*, 2016), and explored the potential of these data for gender-differentiated targeting. Beyond these, there is a growing dataset of standardized household survey data (from IMPACT-Lite and other survey instruments) forming the basis for the systems analysis work (van Wijk, 2014; van Wijk *et al.*, 2014). Team members have also pioneered the use of Systems Dynamics (SD) models that incorporate participatory approaches into integrated ex-ante impact assessments to support priority-setting (Rich, Rich, & Dizyee, 2016), and unlike IMPACT, can be applied at sub-national, value chain, and landscape levels. These SD models will be utilized to better understand the complex interactions between livestock systems, institutions, and livelihood considerations, at a finer level of resolution than is possible with global models.

Second, (Cluster 2) the FP will build on research on gender-transformative approaches undertaken in the L&F CRP. Although part of the conceptual framework for decades (Kabeer, 2014), putting gender and development work into practice remains a key challenge. In Tanzania and Nicaragua, the L&F CRP developed approaches that target young people and women by addressing gender norms through social media. It also explored gender norms affecting participation of farmers in the pig value chain in Uganda, while in Tanzania it supported participatory empowerment pathways (Galiè and Kantor, 2016). The successful experience of the L&F CRP in integrating gender in the technology FPs will also inform further studies on how gender dynamics affect and are affected by technology development. These include: gendered species and breed preferences (Waithanji *et al.*, 2015); social and gendered factors affecting vaccine adoption (Waithanji *et al.*, 2015); women's



decision making in livestock-producing households; and the links between empowerment and nutrition (Njuki *et al.*, 2015; Galiè *et al.*, in press), gender-responsive advisory services (Farnworth and Colverson, 2015), innovation platforms (Mulema and Mazur, 2015), and institutional mechanisms (Pyburn and Mundy 2012); L&F CRP's work with KIT led to a successful collaboration among gender scientists particularly around gender integration and this will be developed further in the Livestock CRP. Linkages with gender work in other CRPs will also be sought, particularly with the gender platform of the CGIAR.

Third, the FP will develop research into a relatively new area, enhancing human nutrition through livestock. Limited evidence exists, as a result of prominent disconnect, whereby livestock interventions often ignore nutritional goals (Dominguez-Salas P, *et al.*, forthcoming). Female animal ownership was found to be a positive predictor of child nutritional status in urban settings (Dominguez-Salas P, *et al.*, 2016), and household livestock production was shown to improve consumption of ASF and enhance macronutrient balance for both adults and children in Uganda (Kabahenda *et al.*, forthcoming). Participation in a pro-poor dairy development intervention through milk hubs improved women's milk consumption in rural Tanzania (Mishkin *et al.*, forthcoming) and women empowerment was associated with improved dietary diversity in women and . In poor urban consumers, affordability of animal-source foods was key to enhance consumption, but other considerations such as access, perceived nutrition value, or tradition played a role too (Cornelsen *et al.*, 2016). Knowledge gaps that will be addressed by this cluster include understanding opportunities to better use various types of animal-source food and other livestock-mediated pathways to enhance rural household food and nutrition security, as part of a whole diet approach. Innovative research on consumption and nutrition will be developed by adapting methods from other disciplines to analyse the drivers of animal-source-food consumption and intra-household allocation of these foods. It will explore innovative ways to deliver interventions, relevant to both livestock-owning households and poor non-livestock-owning households. This research will include strategic interventions including nutrition social and behaviour change communication. The agenda will reflect synergies with solutions developed by the other clusters in priority systems and value chains. Nutritional implications resulting from options implemented by the L&F CRP are currently being explored, particularly in Tanzania (milk value chain), and in Uganda (pork value chain, see box 2.5.b in Annex) and will inform upcoming work, for example, in the dairy and beef value chains in Kenya. The critical mass working on nutrition will be strengthened by building on collaborative relationships already established with topic leaders, national partners and other CRPs, particularly A4NH.

Fourth, (Cluster 4) the FP will conduct research towards integrating technical and institutional innovation at the producer and value chain level, to optimize livestock systems for productivity, livelihoods, and resilience. One area with significant knowledge gaps that will be addressed with new tools is the unique role of livestock assets in promoting resilience through contribution to the accumulation of other livelihood assets, including as a mechanism for moving out of livestock and agriculture altogether. Such analysis requires dynamic observations of men and women farmers' livelihoods and how they adapt them to changing circumstances (Alary *et al.*, 2014). Livestock keepers also face production, marketing, institutional and physical risks as well as gendered barriers. Optimization of resource allocations, with due consideration of the production and marketing challenges (Alary *et al.*, 2011; Siegmund-Schulze *et al.*, 2013), will be essential in increasing the performance and resilience of the sector. Innovative benchmarking, modelling, and programming techniques (Frija *et al.*, 2015; Frija *et al.*, 2011; Varghese *et al.*, 2013; Vera Castillo *et al.*, 2014), including synergies with tools developed in the first cluster, will be used for comprehensive assessments of system performance, and scenarios of production systems dynamics, and which can be used to quantify returns to different livestock investments. While the L&F CRP deliberately tested packages of interventions in specific locations, it has been less successful in overlaying an experimental design that includes the institutional approaches to be tested. Building on recent work by FP members (Omondi *et al.*, 2017; Rao *et al.*, 2016; Omondi *et al.*, 2016), we will test mechanisms to facilitate small and medium scale men and women's access to inputs and services, including farmer cooperatives, private entrepreneurs and franchised systems. Extension and advisory approaches in focus systems and value chains, including options to 'bundle' extension with the delivery of inputs and other services

will be evaluated. Methodological frameworks for measuring and monitoring value chain performance (working with PIM), and thus the potential for creating IPGs, will be improved and applied. These include tools for monitoring and learning from multi-stakeholder platforms, such as innovation platforms (Swaans *et al.*, 2014) and the flexible hub approach (Rao *et al.*, 2015; Twine *et al.*, 2015) and the tools for developing the capacity to facilitate such platforms, such as “blended learning” (Dror *et al.*, 2015). This FP will continue working on models of collective action and tools to evaluate producer organizations’ progress towards sustainability (Baltenweck 2014a and 2014b, Kassie *et al.*, 2008) and resilience. Studies that elicited consumer preferences will be broadened to include all animal-source-food and other products (Kassie *et al.*, 2009; Kassie *et al.*, 2010; Kassie *et al.*, 2011; Terfa *et al.*, 2012; Terfa *et al.*, 2013). Current successful policy work on the upgrading and legalization of the raw milk trade in East Africa and India (Kaitibie *et al.*, 2010), and on informal pig value chains in Vietnam will be expanded.

### **2.5.1.5 Lessons learned and unintended consequences**

Work to date on scenario and foresight analysis has identified three major weaknesses in the application of global economic models such as IMPACT to livestock. First, there is an inadequate capture of the interactions of livestock production with the availability and quality of resources such as feeds, particularly crop residues and pastures. Neither IMPACT (Msangi *et al.* 2014) nor FAO’s GAPS model (FAO 2016a), a comparable multi-market sectoral model, properly take into account environmental impacts or the potential for their management, e.g., the reduction of GHG emissions due to increased livestock productivity. Second, current approaches are unable to model the direct effects of climate change such as temperature and water availability on livestock systems. Third, there has been limited research that models the impacts of future technological or socio-economic change on equity, livestock value chains, and actors, and how such systems themselves will evolve in response. These gaps lead to our current focus on (1) linking the IMPACT model to FAO’s GLEAM model (FAO 2016b) to provide better livestock-crop-feed dynamics, and environmental outcomes and (2) linking global models such as IMPACT to household, herd dynamic, environmental and human decision-making processes. The latter envisions the use and extension of SD approaches to capture meso-level value chain impacts, as well as equity and welfare distributions, associated with livestock sector transitions and interventions (Rich *et al.* 2009; Rich *et al.* 2011; Naziri *et al.* 2015; Rich *et al.* 2016; Lie and Rich 2016; Dizyee *et al.* 2017)

A sound basis was laid for gender research in the L&F CRP. Through the intensive coaching of each of the FPs, lessons have been learned and it is now possible to develop a more nuanced strategic and transformative research strategy. Past gender work on livestock has concentrated on providing access and ownership of animals, without understanding and monitoring the implications and whether it was able to transform and empower. Therefore, based on the research assessing the links between the transformation of gender norms and empowerment pathways (Galiè and Kantor, 2016) there will be research on gender-transformative approaches; addressing gender norms by unpacking concepts, such as, livestock ownership and its implications for empowerment through shifting obligations at household level; exploring gender norms affecting farmers’ participation and entrepreneurship in value chains. In line with this, there will be continued work on the WELI (Women’s Empowerment in Livestock Index), based on the Women’s Empowerment in Agriculture Index (Alkire *et al.*, 2013), but for livestock. To allow for the increased depth of gender research, the gender expertise in each FP will be boosted to work on the more complex issues of gender transformation through the intervention and approaches developed at FP level.

The FP will build on work of the L&F CRP that assessed: the contribution of value chain development interventions and animal-source-food consumption on nutrition of children and adults in priority value chains (Tanzania and Uganda) (Kabahenda *et al.*, forthcoming; Mishkin *et al.*, forthcoming), drivers of animal-source food consumption (Kenya) (Cornelsen *et al.*, 2016) and how women’s empowerment affect maternal and child nutritional status (Tanzania). Despite some successful examples, livestock and value chain development does not necessarily lead to improved nutrition, and might actually make it worse. To avoid unintended consequences in nutrition of value chain development, such as reduced child milk consumption at smallholder level as a result of

increased milk marketing, we will monitor the different impact pathways to nutrition, particularly those related to own-consumption, income generation and women empowerment, and we will design tailored social behavior change strategies to increase the understanding of the households of nutrition and how the value chain interventions can contribute to enhance it. Intra-household allocation is also an essential aspect of animal-source food consumption patterns, and the nutrition implications of distribution asymmetries need to be explored further. The food choices involve wider driver complexity than just accessibility and affordability, and a good understanding of these dynamics can optimize impact.

The L&F CRP did not adequately address the risks in livestock systems which pose major constraints to development. We will draw on the growing body of knowledge on the causes, consequences and management of different risks faced by the livestock sector in the developing world (Bailey *et al.*, 1999; Hazell, 1999; Steinfeld *et al.*, 2006). These include a range of production risks (Kassie *et al.*, 2013) and marketing risk. Farmers have appropriate coping mechanisms for which comprehensive frameworks (Mahul and Stutley, 2010; Chantarat *et al.*, 2013) have been developed. The flagship will use these approaches as part of its work on risk, especially for the fragile growth trajectory in vulnerable systems.

The L&F CRP applied a standard sequence of tools to the value chains in target countries, irrespective of species and current level of development. These steps included value chain assessment, then detailed value chain analysis, followed by identification of priority interventions. This resulted in a lengthy process which delayed the implementation of testable research. In addition, in some value chains, such as dairy in India, some aspects were already well developed and national researchers had already conducted extensive research. In these cases, the initial assessment steps were generally redundant. Our approach will be to consult closely with national partners and review the literature available, and then tailor the value chain work to suit the specific needs. In some cases, this may require the full sequence, but in others we will target specific knowledge gaps already identified. We are for example now in consultation with ICAR in India on plans to conduct spatial analysis of patterns of formal and informal dairy development, to answer questions that have puzzled dairy agencies there for some time.

### 2.5.1.6 Clusters of activity

#### Cluster 1: Policies, foresight and systems analysis

Systematic assessments of the dynamics, drivers, and evolution of livestock production systems, and their links to and interactions with livelihoods, marketing, trade, and consumption, remain an elusive and important research gap. The rapid growth in demand for livestock products (IFPRI 2017) and the resulting supply response is leading to dynamic changes in some production systems, although more rapidly so in some settings, such as in monogastric systems, than in others (Gilbert *et al.* 2015 and Reardon *et al.* 2014). Sections 2.5.1.4 and 2.5.1.5 detail the approaches that will be applied in this work, and the rationale based on lessons learned. To highlight briefly: there is often **limited understanding or consensus as to how livestock supply systems change and evolve**; the **tools for supporting priority setting and decision-making** on technology, investments and policies regarding future livestock production systems, **are not adequate**; and there are **also now new opportunities for linking other models** (SD) to those that project macro trends (e.g. IMPACT). In related work, spatial distribution estimates of the numbers of rural poor who depend on livestock (Robinson *et al.*, 2011) are flawed and need to be updated to account for, amongst others, distributions of poor consumers and other sector actors, and the **potential for increased livelihoods to poor producers**. Finally, national level models such as the Livestock Sector Policy Investment Tool (LSIPT) have been successfully used for Livestock Master Plans such as in Ethiopia (Shapiro *et al.*, 2015), and are increasingly in demand by national governments and other investors such as the World Bank to guide livestock investments. However, unlike in the crop sector, there is a **dearth of current studies examining the returns to livestock R&D investment**. Partly as a consequence, there is significant **public underinvestment in livestock R&D** compared to its economic importance, as well as gaps in our knowledge of the relative impacts of **alternative livestock technology investments**. We know that

feed, breed and animal health are all crucial for livestock performance, but analyses show mixed results in terms of which technologies to prioritize in the short versus long term (Staal et al. 2009). Thus, the aim is not just creating greater strategic awareness of the importance of and opportunities in livestock development to draw greater investment, but also how best to specifically target livestock policy and investment for the greatest desired impact, both within the CRP and among other decision-makers.

#### Main research outputs

- Improved livestock system modelling and data capturing tools developed with partners that more accurately capture livestock system characteristics, crop-livestock interactions, and their evolution.
  - Inventory of modeling gaps followed by development of improved data collection protocols including surveys, participatory process protocols, big data, etc.
  - Adaptation of current indicators for impact assessment –indices that look at social, environmental, institutional, livelihoods dimensions of system change (and possible tradeoffs).
  - Improvements in modeling structures and integration between different levels of analysis i.e., getting IMPACT and other models to talk to one another.
- In target CRP countries, empirical estimates of the levels and structure of supply and demand for animal-source foods in the future, under potential development and climate change and technology scenarios, and foresight analysis of likely patterns of livestock system evolution and dynamics under the above scenarios, under alternative policy and investment regimes.
- Impact assessment of these scenarios in terms of productivity, livelihoods, income, diet diversity, nutrient availability, equity, water use, and GHG emissions, and in terms of return on investment.
  - Projections and impact assessments will be initiated in three target countries, building on the CCAFS Regional Scenarios and adapting them with local expert consultation.
  - Results will allow us to refine the tools, approaches, and scenario development
- Guidance on livestock policy, technology and investment priorities and strategies for the other FPs in the CRP, but also development agencies, decision makers, and the CGIAR.
  - Communications strategies will be developed with advocacy partners and the other CRP FPs and implemented to deliver key findings for action.

#### Outcomes to 2022

1. National and international research partners and policymakers use analyses of livestock-sector dynamics, investment and *ex-ante* impact assessments to guide priority setting, investment and policy development for the livestock sector in five priority countries, and within the Livestock CRP.
2. International researchers and agencies use improved livestock system modelling tools, and apply them to new problems based on their mandate areas

#### Milestones

- Improved data protocols, impact indicators and new model structures will be developed and documented (2020)
- National and international research partners use analyses of livestock sector dynamics, investment and *ex-ante* impact assessments to guide priority setting for the livestock sector in three priority countries (2020).
- National partners and their donors participate in new Livestock Master Plan development in three priority countries, based on bilateral support, and begin to adjust investments accordingly.
- Livestock system modelling tools and databases are improved with national and international partners to fit needs in three priority countries (2020)

#### Cluster 2: Gender and social equity

This cluster will lead the gender and equity agenda of the CRP, ensuring not only that gender-responsive technological and institutional packages are developed and promoted, but that livestock

contributes to **opportunities for empowerment and equitable development**. Balancing the two demands being placed on gender and equity work within the CGIAR, of ensuring the gender and equity gap is reduced to enhance efficiency within the systems, and of using livestock as a means of empowerment, requires a dual approach. As in the L&F CRP, the cluster will continue to integrate gender within FPs, helping them to aggregate, synthesize and provide guidance to gender-integrated research across the CRP FPs. In all cases, this will be guided by the **FP gender specific research questions** in section 1.0.4 of the proposal, but which will develop gender specific research strategies for each FP/technical. It will also continue to systematically study gender relations through integrating gender into baseline studies, research tools, implementation strategies, and monitoring, evaluation and learning tools across all projects. Because of its integrative role, this cluster is also well placed to also develop clear cross FP lessons, and also cross site comprehension on gender. Cross FP joint research is also important as each intervention will place demands on labour, time and require trade-offs, placing this within a gender context and site-specific gender norms can provide important insights into issues of uptake and use of the interventions.

Integrating gender within the FPs is done to ensure equitable benefits and effective uptake of the interventions developed, but also important because this allows for the emergence of a set of gender strategic livestock themes across FPs. These are vital for the overall gender research agenda in livestock, for helping the CRP in prioritization and for the development of IPGs on gender for the CRP. Themes that have already developed include a **shift in focus from livestock ownership to control over benefits, understanding the implications for empowerment of the varied and gendered importance of livestock, re-negotiating obstructive gender norms to enhance equity within the livestock sector, through, but not only, ensuring access to capital and land, and developing synergies between empowerment and nutrition**.

Age is both an intersection of gender analysis as well as a social category in its own right. Young people as a social category were not prominent in the L&F CRP, nor has the participation (or lack thereof) of young people in the livestock sector been analysed as a potential problem. Recognizing this and the opportunities for youth within livestock value chains, the CRP has prioritized development of a strategy on youth (see Annex 3.4). Once formulated, this Cluster will translate the strategy into appropriate research.

#### Main research outputs

- Packages of gender-responsive institutional and technical innovations that are known to enhance productivity and equity.
  - For genetics, developing gender responsive breeding programs that strategically integrate the productivity trait preferences of men and women livestock farmers in East Africa.
  - For environment, identifying gender specific relations to the environment to enhance sustainable livestock management across different livestock systems.
  - For forages, developing investible options for women to be engaged in forages and forages systems in Kenya and Nicaragua.
  - For animal health, research on gender and vaccines and disease management to enhance the already important women play in the care of livestock.
- Gender-transformative approaches developed to address the root causes of gender discrimination, and their effectiveness assessed, and entry points developed within policies, such as the Livestock Master Plans developed under Cluster 1.
- Gender-sensitive indicators and methodologies developed for assessing progress on gender strategic change (e.g. transformation of gender norms or empowerment).

#### Outcomes to 2022

- Policy- or decision-makers in 4 priority countries use the packages developed and the evidence on the benefits of including gender equity considerations In the development of livestock projects and planning at community and national level (Ethiopia, Kenya, Nicaragua, Vietnam)

- Local or national development partners in four priority countries adopt gender-transformative and youth-supportive approaches (using the evidence from the strategic gender research done under the CRP).

#### Milestones

- Gender responsive livestock innovations tested and their impact assessed in two priority countries (2020)
- Policy- or decision makers in two priority countries use evidence on the benefits of including gender equity considerations (2020).
- Gender-transformative approaches that also support young people have been developed and tested and their impact assessed in 4 priority countries (2022).

**Cluster 3: Food and nutrition security through livestock.** Livestock has hugely underused potential to improve the diets of the poorest, particularly during the first 1,000 days of life (young children and pregnant and lactating women) and in areas where livestock represent the key livelihood and production. The consumption of nutrient-dense foods (such as animal-source foods, of high protein quality and bioavailable micronutrient content) is essential (Müller, 2005). The consumption of **milk, eggs, and meat by children has been shown to increase not only physical but also cognitive and social development** (Neumann *et al.*, 2003, Iannotti *et al.*, 2017). Also, women's empowerment has been shown to be a key determinant of intra-household food allocation and nutritional outcomes (Malapit *et al.*, 2015); and we are using a Women Empowerment in Livestock Index to assess links to food security and nutrition. However, evidence of the effectiveness and potential for scaling up of agricultural interventions for nutrition outcomes is still much needed (Ruel *et al.*, 2013, Leroy *et al.*, 2007; Masset *et al.*, 2012). Particularly, studies assessing how livestock production enhancing activities **affect pathways to nutrition have been of limited quantity and quality**. Understanding the dynamics of the linkages of nutrition impacts (to the livestock producers and beyond) with livestock and animal-source food market interventions and with gender dynamics is a critical area that needs to be addressed. Given its mandate, the Livestock CRP is particularly well suited to contribute to these knowledge gaps and assess the nutrition impact of these interventions, as it has the expertise to conduct them and has a wide range of collaborations with institutions working in nutrition (London School of Hygiene and Tropical Medicine, Emory University, Sokoine University of Agriculture, etc.) as well as the A4NH CRP which includes the link with food safety.

This cluster will expand from our current and recent nutrition work in Kenya, Tanzania and Uganda to **understand the animal-source food consumption dynamics** by characterising vulnerable group's diets (particularly for livestock keeping households), **assess their contribution to filling the nutrient gap in vulnerable populations** (including understanding the intra-household food allocation, prioritization and aspects of gender and equity linking with cluster 2), and identify the key drivers of choice as well as barriers and facilitators of consumption, to identify improved market opportunities for livestock products. This will build upon our research investigating drivers of animal-source consumption, demand elasticity in informal settlements and the use of the income generation, the own-consumption and the gender pathways.

In addition, we will test **cost-effective nutrition-sensitive livestock-related interventions** in the most suitable value chains for the specific contexts, to enhance nutrition, based predominantly on the own-consumption, income expenditure and the women empowerment pathways. This will be built on livestock interventions implemented in clusters 2 and 4 (and in other FPs), to which nutrition components will be added. These components will help recognize and exploit the specific pathways to improved nutrition for the most successful animal production or market-based interventions, since evidence suggests that increased livestock and animal-source production, or income generation, might not necessarily lead to higher household consumption or improved nutrition. Examples of such strategies are, improved animal-source food delivery systems and social behaviour communication change. Understanding of livestock-mediated pathways to nutrition and health and how women's knowledge, practices and decision-making power relate to food consumption and health will allow scaling up of the relevant interventions. All the work in this cluster will be closely linked to A4NH.

Main research outputs



- Increased understanding of the impact pathways from production of, and access to, animal-source foods, to improved nutrition in rural households (with clusters 2 and 4), with particular focus in own-consumption, income expenditure and women empowerment.
- Innovative evidence-based approaches for cost-effective nutrition-sensitive interventions that can improve availability, affordability, access and utilisation of animal-source food to small and medium scale producers and consumers, such as cost-effective institutional arrangements and behavioural approaches, designed and tested, with a focus on pregnant and lactating women, children under five years, and adolescent women (with A4NH in the context of full diets).

#### Outcomes to 2022

- Local and national development actors, government agencies, and the private sector invest in and adopt the most successful approaches for enhancing livestock-mediated nutritional impact, including institutional arrangements and behavioural change, in 3 priority countries.

#### Milestones

Local and national development actors and government agencies adopt tailored options for nutritional impact through livestock development, including cost-effective institutional arrangements and behavioural approaches, within communities in Kenya (2020)

#### **Cluster 4: Integrated technologies, practices and institutions for improved livestock systems**

While the other FPs in this CRP look at individual technologies and practices, this cluster **analyses the effect of integrating animal health, feed and genetic technologies and practices to achieve improved productivity and resilience**, and as importantly, assesses **what kinds of institutional arrangements livestock keepers and other value chain actors require to take advantage of these technologies to upgrade their practices and strategies to respond to market forces**. Indeed, market requirements for product attributes (e.g. quality, safety and consistency in supply) are increasing, which may threaten small and medium scale livestock producers' participation in these value chains. This work builds directly and expands on the significant body of similar work developed in the L&F CRP and which is on-going through bilateral funding. As indicated in 2.5.1.5, a more tailored approach to value chain research will be employed.

The focus of the cluster is therefore to evaluate technologies, practices, and institutions for the small and medium enterprise and by doing so, improve their livelihoods through livestock. This evaluation will take into account the multiple roles that livestock play (food, income, savings and insurance, manure) as well as the diversity of market and resources systems. Similar to the 'adoption puzzle' (de Janvry 2017) defined as low adoption rates of seemingly profitable and technically sound technologies in crops, there is low uptake of productivity-enhancing livestock technologies, e.g. fewer than 20% of dairy farmers in Kenya use AI. It has become apparent that solutions to rural poverty arise from agricultural transformation (improving overall agricultural productivity) complemented by rural (non-farm industries and services) transformation. The field experiments done so far (Banerjee and Duflo, 2017) have **insufficiently addressed technologies and institutional arrangements in the livestock sector**, yet these are needed to deliver the needed inputs and services and to ensure market access. Opportunities for developing these innovations in parallel with technologies are growing given new information technology and financing mechanisms.

Using pilot and larger research for development-oriented bilateral projects as 'field experiments', the cluster will **evaluate the appropriateness and impact of technologies, practices and institutions for improving livestock systems and value chain performance** targeting producers across diverse production environments. We will use a range of tools as described in 2.5.1.4, including RCTs where feasible, bio-economic ex-ante modeling at household level, ex-post statistical impact assessment, and scoring and performance protocols for institutional innovation and performance. Tools developed in CL1, particularly SD tools that have been used to directly model impacts and performance in livestock value chains (Dizyee et al. 2017), will be applied in specific cases. These tools will guide learning, development, and implementation of technologies, institutional innovations and full business models to achieve greater and inclusive supply of livestock and animal-source food products to markets, increased access to inputs and services, models of collective action, and

innovative ways to provide extension services. Other clusters in this FP will contribute through targeting, prioritization, and analysis of gender and nutritional implications.

Main research outputs

- Best bet, improved and integrated suite of technologies and management strategies tested and analysed which enhance livelihoods and resilience (or reduce risk) equitably for women, men and young people from livestock-mediated on-farm and off-farm economic opportunities
  1. Target systems include those already advanced in Ethiopia small ruminants, Tanzania dairy, and Uganda/Vietnam pigs
- New inclusive and scalable institutional arrangements developed and tested, that address key needs for a) enhanced product market and value chain performance, b) improved delivery of livestock inputs and services c) meeting demand for product attributes (grades, quality, safety.
- Harmonized ex ante and ex post impact assessments of selected technologies, practices and institutional arrangements across production systems and value chains

Outcomes to 2022

1. Livestock communities across four priority countries apply tested technologies, management strategies and institutional arrangements, taking the multiple functions of livestock into account.
2. Development partners, private sector and government agencies across 4 priority countries apply innovative institutional arrangements to enhance competitiveness and inclusiveness.

Milestones

- Livestock communities across two priority countries apply tested technologies, management strategies and institutional arrangements (2019).
- Development partners, private sector and government agencies in two priority countries apply innovative institutional arrangements to raise competitiveness and inclusiveness (2020)
- Three impact assessment studies conducted on Livestock CRP promoted technologies or institutional arrangements (2022)

### 2.5.1.7 Partnerships

The FP will work with a diverse set of partners to deliver its agenda, building on existing partners and developing new arrangements. Partners bring expertise in science, development implementation, capacity development, and advocacy and communication and include specialized research groups, universities; development agencies, national and international NGOs; public-sector bodies; private-sector companies and entrepreneurs; farmers group; and civil society organizations, such as women's groups. Although some links already exist with the private sector, including dairy business hubs and with input suppliers, new relationships with processors and the food sector will be important.

**Core FP partners** are ILRI, ICARDA and CIAT. ILRI's skills and knowledge relating to the livestock sector cover foresight and priority setting, policy and value chain analysis, gender and livelihoods and integrated action research for livestock livelihoods. ICARDA brings skills in integrated small ruminant development, and CIAT has expertise integrating forages.

**Strategic partners harness scientific comparative advantage** at the regional and global levels. These include KIT on gender research as well as the PIM gender platform. For human nutrition, the FP will work with Emory University's Rollins School of Public Health, and LSHTM, analysing relationships between livestock rearing and nutritional status. For targeting and foresight analysis partners include ULB, FAO, CSIRO, U of Florida and IIASA. The University of Natural Resources and Life Sciences (Austria) working with ICARDA in Ethiopia, brings bio-economic modelling and the design of effective extension service delivery systems.

At **national and local level**, the FP will continue to partner national systems and universities such as SUA on dairy business hubs (Tanzania), Makerere University in Uganda on pig value chain upgrading, University of Nairobi (Kenya) on livestock marking and Centre of Agricultural Policy (Vietnam) on economic modelling. In Ethiopia research is implemented with the Ethiopian Institute of Agricultural Research (EIAR) and the regional agricultural research institutes. In all locations, work with partner universities integrates post-graduate fellows into the research program

**Partners for effective innovation systems in program sites** are essential to achieve target sub-IDOs. These partners bring adaptive research, fieldwork, testing business models and national scaling skills and include NGOs like Heifer International, TechnoServe, Land O'Lakes. Country and local level partners include producers' organisations working on specific value chains and apex organisations.

**Globally, partners for effective scaling** feature as part of regional and global innovation systems and multi-stakeholder platforms that integrate research results into broader initiatives and influence global policy. These partners include Dairy Asia, the Global Agenda for Sustainable Livestock and the inter-agency donor group on pro-poor livestock research and development.

Because of its systems orientation, this FP will link with both the agri-food system CRPs and global integrative CRPs. The former focuses on the contribution of livestock to target farming systems of agri-food systems CRPs. Strong links, many mentioned above, will be developed with PIM on foresight and policy generally, as well as value chains, gender and scaling up, and with A4NH on nutrition. Work with CCAFS will include foresight for climate issues as well as integrated farm-level technologies and strategies related to climate change.

#### **2.5.1.8 Climate change**

Working closely with the Livestock and the Environment FP and with CCAFS, this FP will carry out the trade-off analyses needed to ensure that its intervention packages are optimal in terms of their contributions to emissions without, as far as possible, having a negative impact on other sub-IDOs. The suitability of technologies and interventions will be evaluated based on anticipated climate change and variability at local levels. Particular attention will be paid to the gender and other social and economic dimensions of climate change adaptation. The FP will analyze the additional risks that adapting to climate change brings to households, and test possible incentives that could encourage behaviour change. We will work with the Genetics FP to explore which areas may become more or less suited to different livestock species and breeds.

#### **2.5.1.9 Gender**

Gender is embedded into each FP cluster as well as having a home in cluster 2 (see Annex 3.3). For research priority setting (cluster 1), gender is included the tools, systems analysis and targeting, building on previous research. Strategic gender research in this cluster will explore inclusion of gender dynamics at household or community levels for modelling and scaling work. Cluster 2 research builds on strategic research undertaken in the L&F CRP on meanings of livestock ownership and bridging the gender gap in livestock ownership among others. It also synthesizes, guides and informs gender research across the CRP. Cluster 3 explores women's key roles in household food and nutrition security and the nexus of women's empowerment with nutritional status of household members vis-à-vis livestock development. Cluster 4 will research gendered constraints and opportunities in controlling livestock resources, technology uptake, and policy frameworks that enhance equitable participation in value chains.

**Youth:** Work in this FP will also coordinate the research on inclusion of young people in institutional arrangements in systems and value chains. It recognizes that young people face specific constraints, in terms of access to land, capital, and knowledge. They are also agents of change, given their ability to innovate and use new tools like ICT and mobile technologies, as well as their eagerness to improve their livelihoods. Research will explore delivery of packages of interventions, such as school programs, agri-business enterprise development, and capacity development as well as opportunities for young people remaining in or exiting the sector, especially in the fragile trajectory.

#### **2.5.1.10 Capacity development**

Capacity development will build on the strong legacy of the L&F CRP. The four clusters will engage in capacity needs assessment and intervention strategies to identify gaps between existing and required competencies of both research and development partners (see Annex 3.2). In cluster 4, the FP will assess local and national development partners as part of intervention piloting. Innovative learning materials development and delivery will be carried out in all clusters. Cluster 3 has a large component on the design of and delivery of behavioural communication materials to improve diets and nutrition.

All clusters will also engage in more traditional capacity development activities by supporting fellowships and embedding students in research through collaboration with universities from priority countries and partner universities in the North. Cluster 1 will support institutional capacity development in new modeling methodologies. Enhancing capacities to innovate will be implemented in four clusters. In cluster 4, the focus will be on understanding how change comes about in sites where new institutional arrangements will be promoted, by applying monitoring and learning systems that embed research activity in ongoing processes of change. Gender-sensitive approaches in capacity development will be followed in three clusters, including developing and testing technological and institutional innovations in cluster 4.

#### ***2.5.1.11 Intellectual assets and open access management***

Robust IA management, open access and research data management and communications help in uptake and achieving outcomes (sections 1.0.12, 1.0.13 and 1.0.14 and annexes 3.8, 3.9, and 3.10.7). For IA management, this FP is custodian of much data of different types from different partners and projects, and creates a variety of models, protocols, and know-how that are applied in different projects. The FP's tools and models are mostly accessible online, while consistent use of the Open Data Kit for data collection facilitates systematic recording and storage for re-use and access. While most of the information products of the L&F FP are already open access, the FP will reserve funds each year to supplement bilateral projects to pay article open access fees, and budget these into bilateral projects. A significant challenge is to ensure that more qualitative data, from focus groups for example, is documented and reported and that all the various questionnaires and survey designs are accessible. Projects in the FP make use of various documentation and communication platforms to support this.

#### ***2.5.1.12 FP management***

Implementation will be led by a FP leader (FL), supported by a leader for each cluster (CL). The primary roles of this core team are to develop and update the research agenda and impact pathways, monitor the quality and delivery of knowledge outputs, and report as required. With the CLs, the FL will lead guide FP priority setting, allocation of W1/2 resources and strategic exploration of new research areas; guide development of bilateral projects to ensure alignment to the FP their ability to contribute to strategic synthesis funded by W1/2; coordinate all reporting; support cross-FP initiatives. Cluster leaders will guide research design in their clusters and monitor science quality of outputs, and will also contribute to reporting. Since all clusters have integrating roles across the CRP, CL's will lead cross-FP interactions. Each CL will identify a small group of key scientists across the CRP to develop innovative research design and to review new initiatives. The FP will be led by Steven Staal (ILRI); 20% of his time will be supported by W1/2, with 20% administrative support. Cluster leaders will be: Karl Rich (ILRI) for cluster 1, Nicoline de Haan (ILRI) for cluster 2, Paula Dominguez-Salas (ILRI/LSHTM) for cluster 3, and Isabelle Baltenweck (ILRI) for cluster 4.

## 2.5.3 Flagship Project Annex

### 2.5.3.1 Text boxes

#### Box 2.5b Uganda - integrated approach to value chain transformation in a rapid inclusive growth system

In 2011–2012, the Livestock and Fish CRP identified development of smallholder pig value chains in Uganda as a promising pathway to improve both livestock keepers' livelihoods, as well as the income of other actors along the value chain.

Designed as an integrated approach to transform the whole value chain, initial activities included a situational analysis of the pig sector, as well as participatory site selection with partners. By combining CRP resources with bilateral project funds, ILRI and its partners conducted gender-responsive value chain assessments in specific locations, working with the National Livestock Resources Research Institute, and public universities. Based on these assessments, 'best-bet' interventions, in areas including health and biosecurity, vaccines, feeds, business development, capacity development, slaughtering, and food safety were identified and pilot tested, in close collaboration with local government partners and on-the-ground development partners (including local governments, Kampala City Council Authority, VEDCO, Pig Production and Marketing Ltd., Iowa State University and SNV).

The Program now works with 8,000 pig farmers and 500 pig value chain actors in five districts. A national-level multi-stakeholder platform was set up to identify systemic issues in the pig value chain, connect actors, engage policy-makers and support the sector find long term and sustainable solutions for inclusive and profitable pig value chains in Uganda. Updates and research outputs are online: <http://livestockfish.cgiar.org/focus/uganda>

This approach of focusing and integrating efforts around a particular value chain in selected sites, building long-term relationships with partners, complementing on-the-ground gender-responsive pilot testing of interventions with high quality modeling work and upstream technology research, addressing systemic issues at a higher level and using evidence to adjust interventions when required, is a promising way to reach impact at scale (see Livestock and Fish CRP external evaluation report: <http://hdl.handle.net/10568/52246>).

#### Box 2.5c Tunisia - Integrated systems research to increase farm productivity and reduce vulnerability in a dryland fragile growth system

In 2013, the Dryland Systems CRP targeted the transect Beni Kedache to Sidi Bouzid in Tunisia to increase livestock and crop productivity while improving natural resource management. The area is mainly agropastoral livelihood systems, dominated by sheep, and operating in a fragile environment (aridity index between 0.07-0.2).

Research began with a systems analysis and other assessments to identify constraints and opportunities around water scarcity, rangeland degradation, poor rangeland tenure and poor performance of the two key value chains sheep meat and olives. Water productivity of sheep and goat meat production and seasonal nutritional status and deficiencies of grazing sheep, goat and dromedaries along with feeding practices were assessed, emerging animal health threats such as *theileriosis* and toxoplasmosis were identified, rangeland degradation was mapped, forage plant biodiversity and potential in animal disease treatment was surveyed, value chain analyses of sheep meat and olives identified main stakeholders and marketing channels, and the cost-benefits of water harvesting techniques were calculated.

At the same time, cost-effective and environment-friendly interventions addressing the constraints are being developed involving more than 1500 farmers. These include trials to improve seed productivity and seed system establishment of some key rangeland species, establishing a community-based forage nursery, promoting sustainable pasture management concepts at community level, working on a national pastoral code approach, introducing community-based flock and crop management, off-grid solar-powered solution for on farm-milk cooling, and increasing water use efficiency of feed production. Innovation platforms targeting sheep and olive value chains brought together the Arid Regions Institute with local NGOs and IFAD in a learning alliance. To increase the profitability of products of origin, requests to label two local products as PGI's (Protected Geographical Indication), i.e. Olive oil (variety Zarrazy) and Barbarine sheep meat were submitted to the registration authorities. The proposed CRP Livestock will build on this work to intensify the development and scaling of livestock technologies in a systems context while continuing and complementing environmental impact assessments and development of resource management practices. Additional information is online: <http://mel.cgiar.org/repo>.

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